3 October 1990
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904/265-3677

RELATIONSHIP OF HERD DENSITY AND PHYSICAL PARAMETERS OF WHITE-TAILED DEER IN NORTHWEST FLORIDA PINE FLATWOODS

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Key words: antler, carrying capacity, deer, density, flatwoods, Florida, habitat, nutrition, parasitism, weight, whitetail.

Pine flatwoods is the most prevalent forest type in northwest Florida, where it comprises 32% of all timberlands (Brown 1987). Harlow and Jones (1965a) suggested that the carrying capacity of flatwoods for white-tailed deer (*Odocoileus virginianus*) was approximately 3 deer/km^2, however, subsequent data collected by the Florida Game and Fresh Water Fish Commission (GFC) indicate that some flatwood forests support much higher densities.

Deer from flatwoods characteristically have relatively low body weights and poor antler development (Harlow and Jones 1965b), possibly due to low protein and mineral content of forages (Harlow 1965, Short et al. 1969). Large quantities of deer browse occur in flatwoods (Harlow 1959, Tanner and Terry 1982a), however quality is poor and hard mast availability is low (Tanner and Terry 1982a, 1982b, Wood and Tanner 1985). The relationship between herd condition and population density is not clear. Physical condition of deer may not be sensitive to changes in population density. The objective of this study was to assess the effects of changes in deer density on physical parameters of deer in northwest Florida flatwoods.

STUDY AREA

The study was conducted on the G. U. Parker Wildlife Management Area (9,097 ha), located between the Chipola and Apalachicola rivers approximately 85 km southwest of Tallahassee, Florida, in Gulf and Calhoun Counties. The area was owned by a large timber company, however, the GFC managed deer populations and public hunting. Still-hunting was the only legal method of taking deer.

Pine flatwoods was the predominant habitat type on the area. Based on soil associations, flatwoods and bottomland hardwoods comprised 86% and 14% of the area, respectively. Flatwoods had little topographic relief with poorly drained, acidic, sandy loam soils (Duffee et al. 1984).

Flatwoods were comprised of slash pine (Pinus elliottii) plantations, interspersed with swamps, bays, and drainages. Sweetbay magnolia (Magnolia virginiana), blackgum (Nyssa biflora), and titi (Cliftonia monophylla) were common in these depressions. Common understory vegetation in plantations included gallberry (Ilex glabra), elderberry (Sambucus canadensis), threeawn (Aristida spp.), yaupon (I. vomitoria), waxmyrtle (Myrica cerifera), fetterbush (Lyonia lucida), little leaf titi (Cyrilla parvifolia), and saw palmetto (Serenoa repens). Habitat management was unchanged during the study period. Plantations were thinned after 15 years and harvested on long rotations for poles and sawtimber. Approximately 70% of the area was burned on 3 year rotations.

Bottomlands were dominated by tupelo (Nyssa spp.), cypress (Taxodium spp.), overcup (Quercus lyrata), diamondleaf (Q. laurifolia), swamp chestnut (Q. michauxii), and water oaks (Q. nigra). Understory vegetation was sparse due to frequent flooding.

METHODS

Annual deer density estimates were determined using spotlight surveys (Cook and Harwell 1979). A 10-mile route that sampled approximately 3% of the area was surveyed during the fall or winter of 1980-89.

Biological data and samples including body weight, antler dimensions (i.e., beam length, antler points), abomasa, and lower mandibles, were collected from legal bucks (n = 503) harvested on the area from 1980-89. Legal bucks included any deer with one or more antlers at least 2.5 cm long. Abomasa samples were collected during fall to determine abomasal parasite counts (APC) (Eve and Kellogg 1977). Age was determined from tooth eruption and attrition (Severinghaus 1949). Data were collected by GFC personnel at mandatory check stations or by roving patrol.

Physical parameters of yearling bucks ($\underline{n}$ = 279) were used as an index to herd condition (Taber 1958, McCullough 1979, Severinghaus and Moen 1983). Statistical analyses were done with the System for Statistics (SYSTAT) software package (Wilkinson 1988). Data were transformed if variances were he erogenous as determined by Bartlett's test. Antler point data ere transformed using its square root. One-way analys s of variance (ANOVA) was used to test for differences among ye s for density estimates, and live weights, beam lengths, and nu er of antler points of yearling bucks. Tukey-Kramer tests wer conducted if ANOVA detected differences. Linear regression an yses were used to test the relationship of annual density estim s with mean physiological indices of yearling bucks.

RESULTS AND DISCUSSION

During the early 1980's deer density was re ively high (Table 1) and deer appeared to be in fair physi condition. Deer had relatively low weights and poor antler velopment (Tables 2). A high antlerless harvest was pres bed in 1982 which reduced density (Table 1). Antlerless ha sts were minimized from 1983-85 which stabilized density Antlerless harvests were increased again in 1986-87 which further decreased density. Over the 10-year study period, deer density was reduced by over 3-times. Significant differences ($F = 5.52$; 9 df; $P < 0.001$) were identified among deer density estimates which ranged from 17.2 deer/km^2 in 1982 to 4.5 deer/km^2 in 1987 (Table 1).

Mean APC values ranged from 156-1,190 over the 10-year period (Table 1). Values could be lower than if samples were collected in summer (Eve and Kellogg 1977), however, Couvillion et al. (1982) found no significant difference between mean summer and fall abomasal parasite burdens in the Southeast coastal plain. They suggest that fall APC values are acceptable for assessing herd health in this region. Davidson et al. (1982) reported that abomasal parasitism and herd physical condition were related and both were reflective of the status of deer density relative to habitat carrying capacity. APC values suggest populations were within carrying capacity during the study period (Eve 1981).

Although deer density was reduced, improvements in deer physical condition were not observed. Differences were not found among years for live weight ($F = 0.73$; 9 df; $P = 0.68$), beam length ($F = 0.55$; 9 df; $P = 0.84$), and antler points ($F = 0.62$; 9 df; $P = 0.78$) of yearling bucks (Table 2). Linear regression did not identify significant relationships between deer density and live weight ($R^2 = 0.12$; $n = 10$; $P = 0.33$), beam length ($R^2 = 0.05$; $n = 10$; $P = 0.52$), and antler points ($R^2 < 0.01$; $n = 10$; $P = 0.93$) of yearling bucks.

These data suggest physical parameters and herd health of deer in pine flatwoods are insensitive to changes in population density. Deer in other poor quality habitats in the Southern Appalachian mountains and coastal islands ot Georgia also indicate weak relationships between herd physical parameters and population density (A. S. Johnson, Univ. Georgia, unpubl. data). Our findings are contrary to most studies on the relationship between population density and physical parameters of deer. The relationship between herd condition and density is well documented (Johnson 1937, Park and Day 1942, Severinghaus et al. 1950, Severinghaus 1955, French et al. 1956, Dechert 1967, Cook 1970, McCullough 1979, Kie et al. 1983). These studies found that deer weight and antler development improved after herd reduction.

Most habitat types across the Southeast have enough high quality forage to positively influence herd physical parameters. This positive influence is most apparent on good range when herd density is reduced to the point where competition for quality forage decreases (Leopold et al. 1947, McCullough 1979). However, competition must exist to identify the inverse relationship between deer physical parameters and population density (Eve 1981).

Our data suggest that herd reduction had little effect on nutritional plane, therefore, competition for available food resources may not have changed appreciably. An extremely high amount of browse occurs (Harlow 1959, Tanner and Terry 1982a) and is a major dietary component of deer in flatwoods of northwest Florida (Harlow 1965, Shea et al. 1990). However, Tanner and Terry (1982b) indicated that, although the quality of commonly used browse in flatwoods changed seasonally, the annual mean crude protein content was only 7.7%. They found very little high quality forage which suggests deer may not compete for food sources that could improve herd physical parameters.

This extremely low nutritional level is considered suboptimal for body growth and antler development and may only meet the basal energy requirements of deer (French et al. 1956, Ullrey et al. 1967, Short 1975, Smith et al. 1975, Wallmo et al. 1977, Verme and Ullrey 1984). Wood and Tanner (1985) indicated that the quality of browse in their study of flatwoods deer forage was insufficient to supply adequate digestible energy for growth, reproduction, or body maintenance of deer (Ammann et al. 1973). They also found phosphorus concentrations were well below maintenance-level requirements (Ullrey et al. 1975). The weights of yearling bucks in our study fall within the range indicated by Eve (1981) as minimal survival weights for deer in the Southeast. The abundance of low quality forage and lack of high quality forage in flatwoods could explain why herd physical parameters were low and responses to decreases in herd density were not observed.

MANAGEMENT IMPLICATIONS

Our findings suggest that changes in population density from 4.5-17.2 deer/km^2 did not effect the physical condition of deer and that the carrying capacity of pine flatwood habitats is higher than previously estimated (Harlow and Jones 1965a). Higher herd densities and could be achieved on some areas without causing a reduction in herd physical condition.

Since physical parameters of deer in pine flatwoods appear to be insensitive to changes in density, their use in managing population levels may be limited. It may take longer to identify when populations exceed carrying capacity on areas where physical parameters are used as an index to herd condition. Physical parameters may not provide sufficient warning to avert mortality induced by the synergistic effects of disease and nutrition (Prestwood et al. 1971, Eve 1981). Further research is necessary to identify other parameters or indices that could be used to monitor physical condition of deer in poor quality habitats.

Productivity values also are low in flatwoods of Florida (Harlow and Jones 1965c, Richter and Labisky 1985) and considerably lower than those reported for other herds in the Southeast (Teer et al. 1965, Jacobson et al. 1979, Rhodes et al. 1985). Harlow and Jones (1965c) attributed low productivity of Florida deer to low soil fertility and possible mineral deficiencies. Productivity of deer is dependent on density and its subsequent effect on nutritional plane (Teer et al. 1965, McCullough 1979, Woolf and Harder 1979, Rhodes et al. 1985). Verme (1965, 1967, 1969) demonstrated that productivity is directly related to forage quality.

Richter and Labisky (1985) suggested that lower relative densities could possibly increase productivity in flatwoods; however, productivity would be expected to improve only if density reduction improved the nutritional plane. The poor relationship between population density and herd physical parameters in our study suggests changes in density did not improve habitat nutritional plane. Therefore, we suspect reproductive parameters also may not improve after herd reduction. Further research on the relationship of herd density and productivity is required to fully assess the benefits of herd reduction in poor quality habitats in Florida.

This study suggests the inverse relationship between deer density and physical parameters may not be readily apparent in habitats containing abundant, low quality forage. Commonly accepted deer harvest management strategies may be inappropriate in these habitats. Deer harvest management must be evaluated based on area-specific biological data, including forage quality. Gross (1972) and McCullough (1979) stated that intuition regarding reproductive rate, population density, nutritional plane, and range condition sometimes leads to erroneous conclusions about deer management.

This study was the product of annual biological data collected to make deer management decisions on a public hunting area. Population management strategies could not have been evaluated without the comprehensive data collected during the study period. Similar relationships between population density and herd physical and reproductive parameters could be present in other herds in Florida and the Southeast. Further analysis is necessary to determine the scope of these results in Florida. However, white-tailed deer management in other poor quality habitats should be critically evaluated in order to determine the practicality and assess the effectiveness of applying commonly accepted deer harvest management principles.

SUMMARY

Biological data from white-tailed deer harvested from a pine flatwood study site in northwest Florida from 1980-89 were used to evaluate the relationship between herd density and physical parameters. Deer density was reduced significantly ($\underline{P} < 0.001$) during the study period, however, no differences were observed among years between live weight ($\underline{P} = 0.68$), beam length ($\underline{P} = 0.84$), and antler points ($\underline{P} = 0.78$) of yearling bucks. Linear regression also failed to identify significant relationships ($\underline{P} > 0.05$) between population density and these parameters.

Although density was reduced by over 3-times, improvements in deer physical parameters were not observed. It appeared that herd reduction did little to improve nutritional plane. Apparently, the physical parameters of deer were insensitive to changes in density and their use in population management on poor quality habitats may be limited.

Acknowledgements.--The authors are grateful to D. Dowling and W. Bartush for their assistance with data collection and deer management on the study area. We also appreciate the efforts of

Neal Land and Timber Co., especially P. McMillan and J. Parker for their commitment to deer management. D. Beyer, D. Cobb, and T. O'Meara provided assistance with statistical analyses. W. Davidson, A. Johnson, L. Marchinton, and K. Miller provided valuable editorial comments. Funding was provided by the GFC through Federal Aid in Wildlife Restoration Project W-35-D.

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Table 1. Antlerless harvests, density estimates, and APC values of deer on G. U. Parker Wildlife Management Area from 1980-89.

Year	Antlerless harvest	Deer density (deer\km²)[a]			APC		
		$\bar{x}$	SE	n	$\bar{x}$	SE	n
1980	18	15.4 BD	2.8	4	1190	256	4
1981	19	12.1 ABC	1.0	4	982	320	13
1982	121	17.2 CD	1.5	3	418	54	11
1983	29	8.9 AB	0.8	6	530	91	8
1984	33	8.1 ABC	2.6	3	289	75	9
1985	33	8.9 AB	2.2	3	236	82	5
1986	64	9.6 ABC	2.5	6	156	38	5
1987	63	4.5 A	0.5	6	475	272	4
1988	35	7.8 AB	1.0	5	212	99	5
1989	00	5.3 A	1.3	6	296	113	5

[a] Means followed by the same letter are not different ($P > 0.05$ Tukey-Kramer test).

Table 2. Live weight, beam length, and antler points of yearling bucks on G. U. Parker Wildlife Management Area from 1980-89.

	Live weight (kg)			Beam length (cm)			Antler points		
Year	$\overline{x}$	SE	n	$\overline{x}$	SE	n	$\overline{x}$	SE	n
1980	39.5	3.6	5	10.3	3.6	5	2.4	0.4	5
1981	38.0	2.0	10	10.5	3.1	10	2.9	0.5	10
1982	42.4	3.0	13	12.9	2.7	13	2.8	0.4	13
1983	41.9	2.2	11	11.7	2.4	11	3.2	0.5	10
1984	40.8	1.6	29	13.7	1.5	25	2.4	0.2	25
1985	40.8	1.6	17	11.1	1.5	15	2.7	0.2	15
1986	39.6	1.6	21	9.8	1.9	20	2.4	0.2	20
1987	42.3	0.9	48	12.4	1.0	49	2.7	0.2	48
1988	42.8	1.0	49	12.9	1.0	48	2.8	0.2	46
1989	41.8	1.1	50	11.8	1.1	49	2.5	0.1	49